IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re:	Paul Mattackal Verghese	Confirmation No:	6972
Serial No:	10/743,238	Group:	2872
Filed:	December 22, 2003	Examiner:	Chang, Audrey Y.
For:	Dual Membrane Single Cavity Fabry Perot MEMS Filter		
Customer No.:	25263		
Attorney Docket No.	0005.1120US1		

APPELLANT'S BRIEF

VIA FACSIMILE: **571-273-8300**
Mail Stop Appeal Brief- Patents
Commissioner for Patents
P.O. Box 1450,
Alexandria, Virginia 22313-1450

Sir:

This is the appeal from the final Office Action, mailed November 6, 2006 (Paper No. 20060801).

Real Party in Interest

Axsun Technologies, Inc. is the real party in interest.

Related Appeals and Interferences

There are no related appeals or interferences.

Status of Claims

Claims 1, 2, 4-11, 14, and 17 are pending in the application. Claims 1, 2, 4-11, 14, and 17 are rejected.

Status of Amendments

All amendments have been entered. There were no post final amendments or proposed amendments. However, a Petition Under Rule 181 has been filed relative to the pending objections.

Summary of Claimed Subject Matter

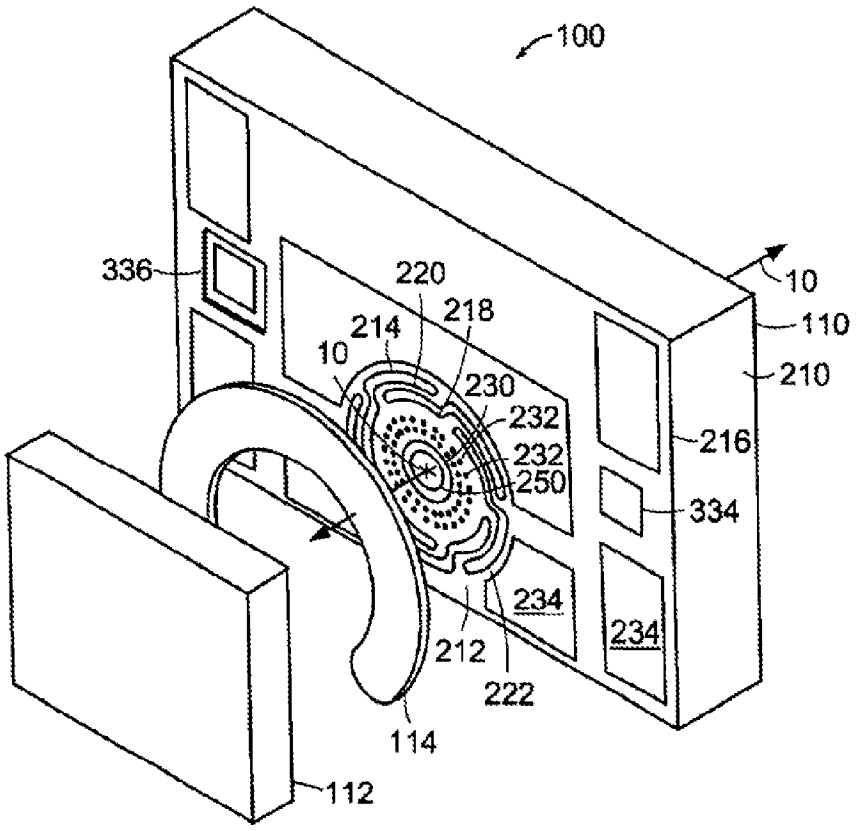
The present claimed invention generally relates to Fabry-Perot tunable filters and specifically Fabry-Perot tunable filters constructed from micro-electro-mechanical systems (MEMS) devices.

Fabry-Perot tunable filters are opto-mechanical devices that are used to spectrally filter optical signals. Minimally, they have two opposed mirrors that thereby define an optical cavity. This optical cavity will be generally transmissive to optical wavelengths for which an integer number of wavelengths fit into the cavity, the resonant condition. Other optical wavelengths will be generally reflected by the cavity.

Single cavity Fabry Perot filters have a very sharp spectral passbands, Airy function. That is, the only optical wavelengths that are very close to the resonant condition are transmitted through the cavity. Most other wavelengths are reflected.

The present invention is possibly best understood within the context of the evolution of the MEMS Fabry Perot filters that have been patented and commercialized by the assignee, Axsun Technologies, Inc.

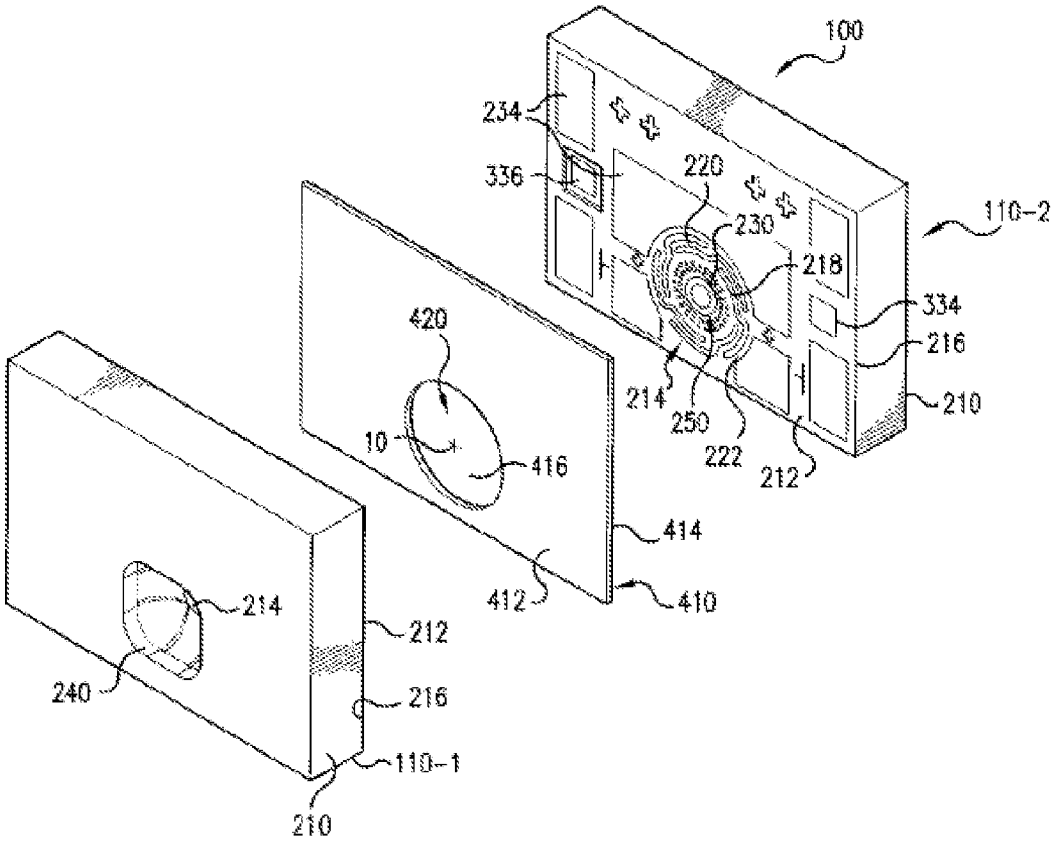
An exploded view of Axsun Technologies standard MEMS Fabry Perot tunable filter is shown below. This image was taken from U.S. Patent No. 6,768,756, issued July 27, 2004, entitled, "MEMS Membrane with Integral Mirror/Lens" (hereinafter Flanders, *et al.*'756 Patent).



This single cavity MEMS Fabry Perot tunable filter comprises a MEMS membrane device 210. (Note for the ease of understanding, the terminology of the instant application is adopted in these descriptions.) The device 210 includes a deflectable a membrane 218. An electrostatic drive voltage is used to deflect this membrane 218 out of plane. As a result, the length of the optical cavity, which is defined by mirror 250 and a second mirror on the backside of mirror die 212, is changed with the deflection of the membrane 218. The gross length of the cavity is generally set by the intervening spacer 114.

This single cavity MEMS Fabry Perot tunable filter was a central innovation of Axsun Technologies, Inc. The MEMS-based design allowed semiconductor fabrication technologies and micro-assembly technologies to be used to fabricate and mass produce these Fabry-Perot tunable optical filters for applications extending from spectroscopy to telecommunications.

The figure below is taken from U.S. Patent No. 6,424,466 to Flanders (hereinafter Flanders '466 Patent). Flanders '466 Patent is currently being applied against the claims of the present application and is similarly owned by Axsun Technologies, Inc.



This figure is an exploded view of a variant of the standard MEMS Fabry-Perot tunable filter shown above from the Flanders, *et al.*'756 Patent. Specifically, the Flanders '466 Patent describes a dual cavity MEMS Fabry Perot filter.

The dual cavity filter has two membrane devices, both labeled 210. Further, there is an intervening stationary mirror 416 between the two deflectable mirrors 250 that are supported on the membranes 218 of the two membrane devices 210.

Fig. 4 from the Flanders '466 Patent below is a cross sectional view that illustrates the dual cavity design. Specifically, mirrors 250 control the size of two optical cavities, one optical cavity on either side of the central stationary mirror 416.

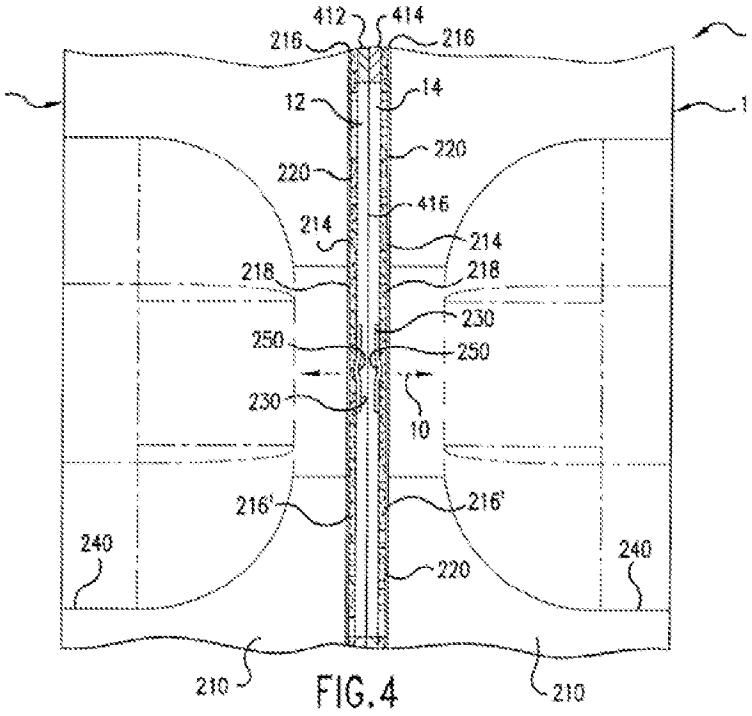


FIG. 4

A dual cavity Fabry Perot tunable filter is more appropriate for certain applications where a tunable broader passband is required. Specifically, by separately tuning the two optical cavities and carefully controlling their relative sizes, a broader passband can be produced than the very narrow passband associated with a single cavity Fabry Perot tunable filter. Thus, such dual cavity Fabry Perot tunable filters are appropriate for applications such as wavelength add/drop devices.

Fig. 6 below, showing an exploded view, was taken from the present application. Specifically, it shows two membrane devices A, B. They each have a center mirror 128 (128A being shown in Fig. 6). These mirrors 128 sit on a deflectable membranes 120. An intervening spacer is used to separate the two membrane devices A, B.

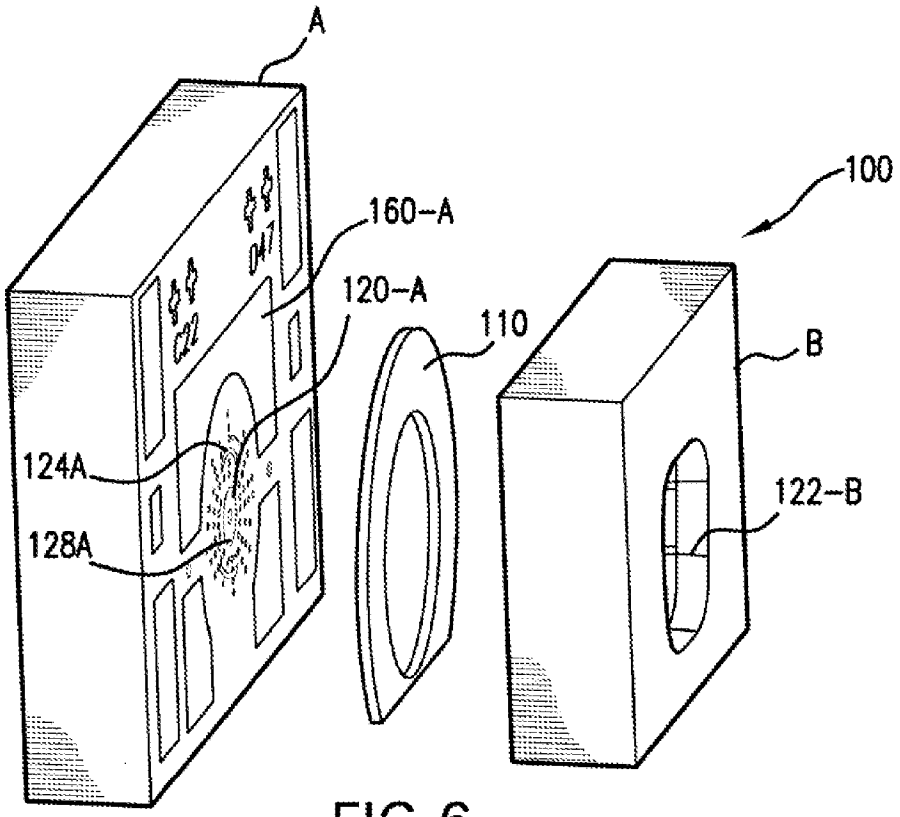


FIG.6

When assembled, the result is shown in the schematic Fig 3 below. Specifically, the membranes 120-A, 120-B, and specifically the mirrors that they carry, oppose each other across an optical cavity, the size of which is grossly defined by the spacer 110.

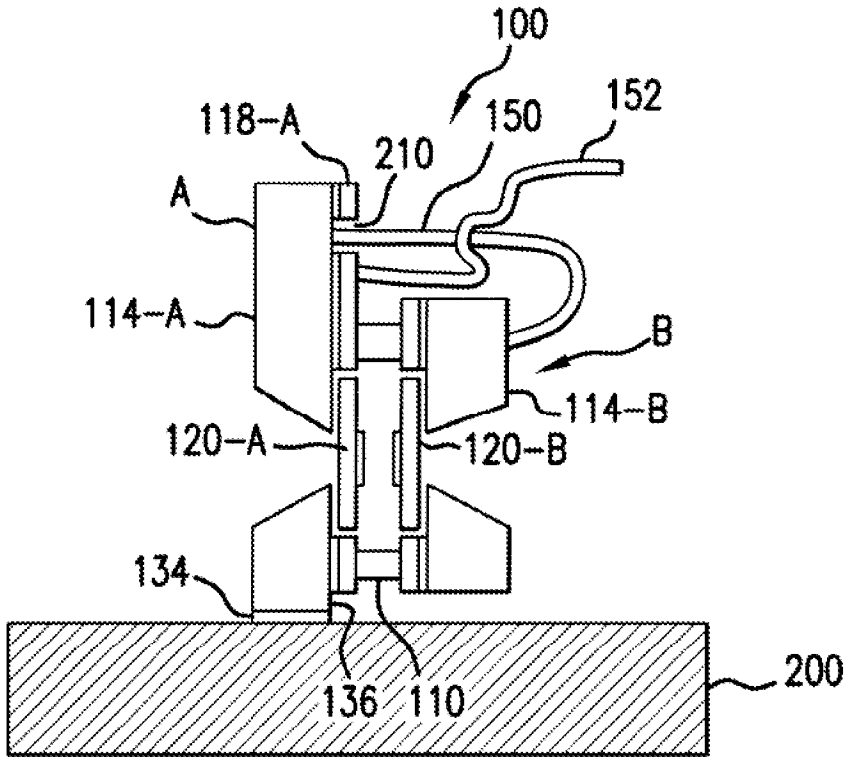


FIG.3

In summary, the present invention is somewhat of a hybrid device relative to the devices shown above from Flanders, *et al.*'756 Patent and the applied Flanders '466 Patent. Specifically, it uses two opposed membrane devices A, B similar to the applied Flanders '466 Patent. However, it is a single cavity device similar to that shown in the Flanders, *et al.*'756 Patent. Specifically, the invention does not have the intervening mirror 416 of the applied Flanders '466 Patent.

The innovation of the present invention is best understood relative to the Flanders, *et al.*'756 Patent. The throw of the optical cavity, *i.e.,* the degree to which the length of the optical cavity can be changed, is limited to how much deflection can be achieved from the single membrane 218 of the membrane device 210 from the Flanders, *et al.*'756 Patent. In contrast, as illustrated in Fig. 3 of the instant application, the size of the optical cavity can now be changed by essentially twice the distance that a single membrane

device can move. Another less evident advantage is the fact that if the membranes 120-A, 120-A of the membrane devices A, B of the present application have similar rigidities, then the single cavity Fabry-Perot filter of the present invention will not be sensitive to its orientation within the gravitational field. That is, the system design of the Flanders, *et al.*'756 Patent had to account for the fact the orientation of the membrane device in the gravitational field of the earth could affect the deflection of the membrane due to its weight. In the contrast, with the present invention, since the membranes 120-A, 120-B, will be exposed to the same gravitational field but the gravitational field will deflect them in opposite directions, the device lo0ses much of its sensitivity with respect to its orientation making the device much more robust and less dependent on the specifics of its ultimate installation.

Grounds of Rejection to be Reviewed on Appeal

Whether claim 14 contains subject matter that was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention.

Whether claims 1, 2, 4-11, 14, and 17 are unpatentable over the Flanders '466 Patent in view of the patent issued to Russell *et al.* (PN 6,384,953) (hereinafter Russell *et al.* Patent).

Argument

Arguments relative to whether claim 14 contains subject matter that was not described in the specification:

The rejection does not set forth its basis. Instead, it in effect incorporates by reference remarks earlier in the Office Action.

Nevertheless, it appears that the crux of the support for the rejection is the new matter objection expressed in the paragraph bridging pages 2 and 3 of the Pending Office Action:

> *deflection* of the second membrane". The specification **fails** to provide the support for the "flexures" to enable the deflection of the membrane. The deflection is caused by electrostatic force not flexures. Paragraph {0024} of the specification specifically states that the flexures 124 are formed to "control the flexibility of the membrane". To **control flexibility** of the membrane is **not the same** as causing the membrane to deflect. The deflection again is caused by the electrostatic force not by the flexibility of the membrane and therefore not by the flexures.

The arguments above correctly point out that the deflection of the membrane is "caused" by the electrostatic force and not the flexures. The arguments also correctly point out the content of paragraph [0024] of the specification.

The arguments do not, however, articulate any reason why the claimed invention, *i.e.,* flexures "enabling" the electrostatic deflection, is not supported by the specification other than the conclusory statement of the first full sentence above. Instead, the arguments are premised on the belief that claim 14 states that 'the flexures "cause" deflection', see for example: "To control flexibility of the membrane is not the same as causing the membrane to deflect", or "The deflection again is caused by the electrostatic force not by the flexibility of the membrane and therefore not the flexures" [emphasis added].

In short, the Office argues that it would be incorrect to describe the flexures as "causing" deflection. This, however, is not relevant with respect to the claim language, which provides for "flexures enabling the deflection."

In fact, the flexures do "enable" membrane deflection. Without the flexures, the membrane would not deflect with the relatively weak electrostatic force. In this sense, the flexures enable the membrane to deflect with the electrostatic forces.

Thus, the rejection "objects" language, *i.e,* 'cause', that is not present in the claim.

Arguments relative to whether claims 1, 2, 4-11, 14, and 17 are unpatentable over the Flanders '466 Patent in view of the Russell *et al.* Patent:

The invention of claim 1 is very similar in many respects to the dual cavity Fabry-Perot tunable filter shown in the applied Flanders '466 Patent. They both have two membrane devices. Each of those membrane devices holds a mirror structure and has a first substrate for supporting the membrane and defines an electrostatic cavity between the membrane and the substrate. Each of the membrane devices of the Flanders '466 Patent utilizes an electrostatic voltage between the membrane and the substrate to cause deflection of the membrane relative to the substrate. In fact, for the purposes of the claim language, the claimed membrane devices are identical to those of the Flanders '466 Patent.

To be completely, brutally, deconstructionist, the only difference between the present claimed invention and the dual cavity Fabry Perot tunable filter of the '466 patent is the removal of the center mirror 416 as shown in Fig. 4 of the Flanders '466 Patent.

Thus, claim 1 is distinguishable over the Flanders '466 Patent insofar as it requires a "single cavity dual membrane Fabry Perot tunable filter" and "a second membrane device . . . which is opposed the first membrane structure to thereby define a Fabry Perot cavity between the first mirror structure and the second mirror structure." In contradistinction, the mirrors 250 of the Flanders '466 Patent define different Fabry Perot cavities on either side of the center mirror 416.

It is the contention here that, in effect, removing the center mirror 416 of the device shown in the Flanders '466 Patent would not have been obvious.

First, nothing the Flanders '466 Patent suggests that this mirror 416 should be removed.

In ways, the dual cavity device shown in the applied Flanders '466 Patent is not analogous to the present invention. That is, the present invention is applicable to such applications as spectroscopy and the tuning devices in external cavity lasers, because of its very sharp passband. In contradistinction, the dual cavity device from the Flanders '466 Patent is relevant to an entirely different spectrum of applications. That is, since it can be tuned to provide a relatively wide passband, it is more applicable to add/drop

optical systems. Thus, one skilled in the art would never be motivated to modify the device shown in the Flanders '466 Patent by removing the central mirror. That person skilled in the art at the time of the invention would, after contemplating removal of the center mirror 416, simply understand that the removal completely changes the optical characteristics of the device such that it is no longer appropriate to the applications for which the Flanders '466 Patent was intended.

The present rejection is based upon the combination of the Flanders '466 Patent with the Russell et al. Patent. Russell is very analogous to the single cavity MEMS Fabry Perot tunable filter of the Flanders, *et al.*'756 Patent described in the Summary above. It shows two opposed mirrors 44, 46 shown in its Fig. 2A:

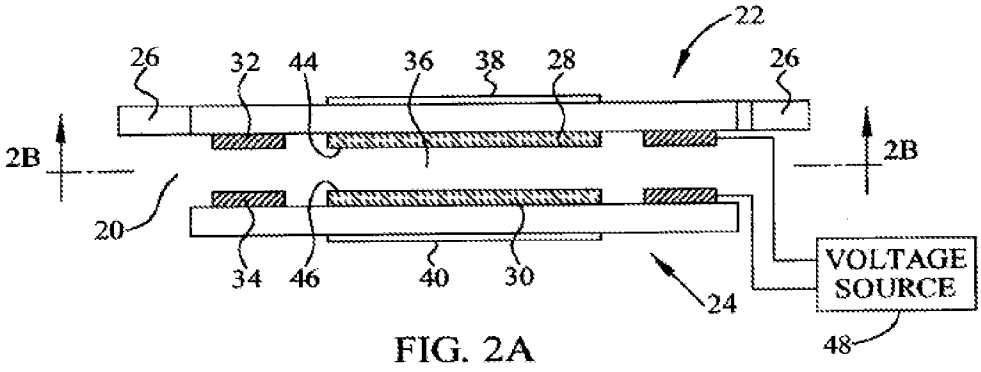


FIG. 2A

Only mirror 44 is positioned on a MEMS membrane device 22, shown in Fig. 2B:

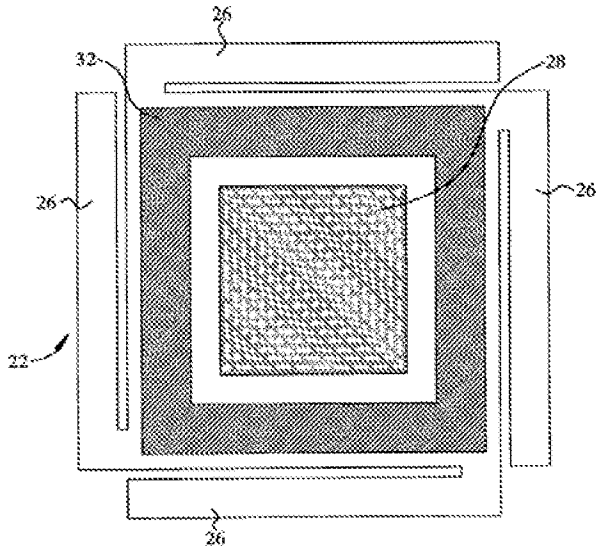


FIG. 2B

In this way, only mirror 44 deflects in response to an electrostatic field set up between the mirrors 44 and 46 by voltage source 48, see Fig. 2A, above. There is no suggestion in the Russell et al. Patent that the Fabry Perot cavity should be constructed from two devices having the flexible spring mounts 26.

The pending Office Action has provided two motivations for the modification of the dual cavity Fabry Perot filter from the Flanders '466 Patent into the single cavity design of the Russell *et al.* Patent.

First, the Office Action argues that it would obvious to remove the center mirror from the Flanders '466 Patent because it would require only "single frequency tuning." From page 6 of the pending Office Action:

> defined between the movable mirror structure to define *a single cavity tunable filter*. It would then have been obvious to one skilled in the art to apply the teachings to Russell et al to make the tunable Fabry-Perot filter of Flanders *a single cavity one* by simply removing the intermediate mirror so the two mirror structures (250) supported by the two membrane devices defines a single Fabry-Perot cavity between them for the benefit of making the tunable filter applicable in the systems that require only single frequency tuning.

From a technical standpoint, this argument is without logic. It is not known what "single frequency tuning" is. None of references show "single frequency tuning", "single frequency tuning" is not a characteristic of any known physical device.

Secondly, the pending Office Action is based on a flawed understanding of the operation of device shown in the Russell *et al.* Patent. Specifically, the Office Action argues that the Russell et al. Patent has <u>two moveable</u> mirror structures. From page 6 of the pending Office Action:

> two mirror then only a single cavity (and a single resonance frequency) can be established. **Russell** et al in the same field of endeavor teaches explicitly of such single cavity Fabry-Perot tunable filter design wherein two movable mirror structures are disposed as opposing to each other such that a *single cavity* is defined between the movable mirror structure to define *a single cavity tunable filter*. It would then have

This fact is simply incorrect. Only mirror structure 44 has the "flexible spring mounts 26" that enable it to deflect. Mirror 46 of the Russell *et al.* Patent is stationary.

Thus, in summary, the present invention's arguments for the combination of the references are both without merit from a technical standpoint in terms of motivation to combine and are also based on an incorrect understanding of the applied references, particularly the Russell et al. patent.

Thus, it is respectfully asserted that this rejection is in error.

For the foregoing reasons, it is believed that the pending rejections should be withdrawn, and that the present application should be passed to issue. Should any questions arise, please contact the undersigned.

Respectfully submitted,

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Date: June 6, 2007

Claims Appendix

1. (Previously presented) A single cavity dual membrane Fabry-Perot filter comprising:

a first membrane device comprising: a first membrane holding a first mirror structure, a first substrate for supporting the first membrane and defining a first electrostatic cavity between the first membrane and the first substrate, an electrostatic voltage between the first membrane and the first substrate causing deflection of the first membrane relative to the first substrate; and

a second membrane device comprising: a second membrane holding a second mirror structure, which is opposed the first mirror structure, to thereby define a Fabry-Perot cavity between the first mirror structure and the second mirror structure, a second substrate for supporting the second membrane and defining a second electrostatic cavity between the second membrane and the second substrate, an electrostatic voltage between the second membrane and the second substrate causing deflection of the second membrane relative to the second substrate.

2. (Previously presented) A Fabry-Perot filter as claimed in claim 1, further comprising a spacer between the first membrane device and the second membrane device for controlling a size of the Fabry-Perot cavity.

3. (Cancelled)

4. (Previously presented) A Fabry-Perot filter as claimed in claim 1, wherein the first mirror structure and the second mirror structure are flat mirrors.

5. (Previously presented) A Fabry-Perot filter as claimed in claim 1, wherein at least one of the first mirror structure and the second mirror structure is curved mirror structure.

6. (Previously presented) A Fabry-Perot filter as claimed in claim 1, wherein, the both the first mirror structure and the second mirror structure are curved mirrors.

7. (Previously presented) A Fabry-Perot filter as claimed in claim 1, wherein the membrane devices comprise respective substrates, the membranes being deflected by the establishment of electrostatic drive voltages between the substrates and the membranes.

8. (Previously presented) A Fabry-Perot filter as claimed in claim 7, further comprising an optical port through at least one of the first substrate and the second substrate.

9. (Previously presented) A Fabry-Perot filter as claimed in claim 1, wherein the mirror structures comprise highly reflecting dielectric mirrors.

10. (Previously presented) A Fabry-Perot filter as claimed in claim 1, wherein a drive voltage generator establishes a voltage in the first electrostatic cavity and the second electrostatic cavity.

11. (Previously presented) A Fabry-Perot filter as claimed in claim 1, wherein a drive voltage generator establishes a drive voltage between the membrane of the first membrane device and the membrane of the second membrane device.

12. (Cancelled)

13. (Cancelled)

14. (Previously presented) A Fabry-Perot filter as claimed in claim 1, wherein first membrane comprises flexures enabling the deflection of the first membrane relative to the first substrate and second membrane comprises flexures enabling the deflection of the second membrane relative to the second substrate.

15. (Cancelled)

16. (Cancelled)

17. (Previously presented) A Fabry-Perot filter as claimed in claim 1, further comprising a first optical port through the first substrate and a second optical port through the second substrate.

Evidence Appendix

None

Related proceedings appendix

None